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(19)

(54) A DEVICE FOR SECURING IN THE JAW BONE FOR THE ATTACHMENT OF A DENTAL PROSTHESIS

(71) We, AGA AKTIEBOLAG, a Swedish Company, of 181 20 Lidingo, Sweden, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

In order to secure permanently a prosthesis and the like in a human body, especially a dental prosthesis, the use of a device comprising at least two parts has been proposed, the device serving to attach the prosthesis to skeleton tissue. If such a two-part device is used, a first part thereof is intended to be applied in such a way in the skeleton tissue that it will remain embedded therein throughout the time during which a wound caused by preparing in the tissue a cavity for receiving said first part heals. Moreover, the tissue will attach itself to the embedded part during the healing process. A second part of the device serves as a spacer between the first part and the prosthesis. It is so shaped that it may be attached to the first part and that it will pass through superficial, weak, tissue which covers the skeleton tissue. The spacer is thus intended to serve as a link between the first part embedded into the skeleton tissue and the prosthesis which will be located outside of the weak tissue.

The main, but not exclusive, use of such permanently implantable devices is in connection with the permanent attachment of dental prosthesis to the jaw bones in human bodies. The jaw bones are often of narrow cross-section, and irregular in their longitudinal direction, which means to say the orientations of different parts of the same jaw and/or the same jaw bone differ but, more important, the upper jaw and the lower jaw differ in orientation. This is one of the causes of the so called over-bite, or under-bite, respectively. As the devices require, for technical load reasons to be well centred in the jaw bones, they will frequently be offset relatively to one another in the longitudinal direction in the same jaw, and even more offset as between the upper jaw and the lower jaw. This is a serious disadvantage, because the longitudinal direction of the teeth in the prosthesis is in agreement with the longitudinal direction of the securing device. Any compromise causes a weak or completely unsatisfactory attachment in the jaw bone or a misorientation of the tooth prosthesis.

Therefore, there is a need for a two-part attachment, or securing, device in which the part that is embedded in the jaw bone may form an angle with the other part to which the prothesis will be attached. The present invention aims at providing an attachment device which will serve to satisfy said need.

Accordingly, the invention provides a device for securing in the jaw bone for the attachment of a dental prosthesis, the device comprising a first member and a second member; ball joint means between said first member and said second member to permit universal movement between said members, said ball joint means comprising a co-operating ball part and socket part and there being provided manually adjustable means for displacing the ball part relative to the socket part whereby said ball part may be moved into firm engagement with the socket part to lock the joint and secure said members in a predetermined relationship relative to each other.

In order to make the invention more readily understood and to explain some or its subsidiary features, some embodiments thereof will now be described in more detail with reference to the accompanying drawings, in which:

Figure 1 shows a device according to the

invention including a single ball joint, and in which the ball part is attached to the first member of the device intended to be embedded into the jaw bone, whereas the socket part co-operating with the ball part is attached to the second member to which the prosthesis is intended to be attached;

Figure 2 shows an arrangement, in which the ball part is hollow and instead of being attached to the first member is formed integral therewith;

Figure 3 shows the same arrangement as in Figure 2, except that it comprises two ball joints in cascade after each other;

Figure 4 shows an arrangement including manually adjustable means in the form of a tensioning wire for displacing and locking, respectively the ball part relative to the socket part;

Figure 5 shows an arrangement similar to that of Figure 4 except that the first and second members are each provided with a socket part engaging a ball part disposed between them; and

Figures 6 and 7 show a modification of the arrangement according to Figure 2.

In the arrangement according to Figure 1 a first member to be implanted into the jaw bone comprises a bolt-shaped component 10 which is externally screw-threaded as indicated at 13 for screwing into a hole drilled in the jaw bone and provided with an internal thread. The member 10 is provided with a bore 11 which is open at the bottom of the member 1 and which communicates through radially directed openings 12 with the outside of the member 10. The openings are intended to facilitate skeleton tissue to grow thereinto since such "in-growth" will secure the member 10 more firmly in the skeleton tissue. The upper end portion of the member 10 is provided with a flange 14 for the reception of a free collar 15 the internal concave surface of which forms a support for a socket 19 of the above mentioned ball joint. The socket 19 in turn accommodates a ball 16.

The ball 16 is attached to a shaft 17 which is externally threaded at its lower end 26 and is screwed into the member 10 which, for this purpose, is provided with an internally threaded bore 18. Between the inner concave surface of the collar 15 and the convex spherical part of the ball 16, the socket 19 is placed, which is attached to a second, upper, member 20 of a device according to the invention. This member 20 is designed in such a way that it will provide a good fixture for a prosthesis 21, but fixing the latter to the device is a detail which does not form part of the present invention, and it will therefore not be further described. The member 20, however, is provided with an internally threaded through-hole 22 extending in the axial direction. In to the hole 22 is screwed an externally threaded pin 23 having, for the purpose of turning it, pin-engagement means, for instance a screwdriver groove 24. In Figure 1 the screwdriver groove and an adjacent upper end portion of the hole 22 are shown as having been filled with cement, amalgam or any similar filler mass. The pin 23 is provided at its lower end portion 25 with a preferably conical recess having a top angle such that, when the pin is tightened the edge of the recess will be pressed against the ball 16 and lock the latter against movement relative the member 20 of the device.

When a device of the kind hereinbefore described is to be implanted into the jaw bone of a patient requiring to be fitted with the prosthesis 21, the dental surgeon will proceed by first providing a suitable cavity in the jaw bone, for example by drilling the latter, and thereafter by cutting an internal thread into the cavity, which thread will serve for screwing the first member 10 of the device into the cavity. The dental surgeon, in the course of performing these steps, can determine the axial direction of the cavity so that it will be centred, in the best possible way, in the jaw bone and so that it will not be in immediate vicinity of the side surfaces thereof. Depending on the shape of the patient's jaw bone, this will in many instances lend to a situation in which the axis of the drilled and threaded cavity extends in a direction which is angularly inclined relative to the direction which the axis of the upper member 20 must assume to accommodate the shape and the required position of the prosthesis. Having prepared the cavity in the manner indicated, the dental surgeon then proceeds to screw in the lower member 10. He may seal the top of the member 10 by means of a temporary filling of some suitable kind or, alternatively, he may insert a temporary filling into the whole of the bore 18. Any superficial, or weak, tissue folded aside for the purpose of preparing the cavity will be folded back over the top of the member 10 not only to permit this weak tissue to heal but also to promote healing of the wound caused by cutting, or drilling, the cavity in the jaw bone. Thus, the lower member 10 is allowed to become "integrated" with skeleton tissue, or other hand tissue, growing together around the outer surface of the lower member 10, for which purpose said surface has previously been grooved or in any other suitable way roughened. Further, skeleton tissue will grow into the openings 12. Once the skeleton tissue has grown as indicated, the member 10 will effectively be prevented from being screwed

out of the cavity.

The lower member 10 will be left in the condition mentioned, to become "integrated" with the jaw bone, which will take some time, on average, about six weeks. After the completion of the healing process the dental surgeon will re-cut the weak tissue that has healed over the lower member 10, thus uncovering the latter. The surgeon will also remove the temporary filling at the top of the member 10 and/or in the bore 18 and screw into the latter the shaft 17 along with the ball 16, after having applied the collar 15 to the upper end portion of the member 10. At this time the member 20 and the bolt 17 should assume a straight line and be locked in this position by means of the pin 23. When the shaft 17 is completely screwed into the bore 18 so that the socket 19 is in contact with the collar 15 the threaded pin 23 is slightly released and the member 20 is corrected into the desired direction. The member 20 having thus been give the correct direction is again locked in this position by means of the pin 23 so that it cannot be moved any further. When the upper and lower members including all components are mounted as set out, the dental surgeon will take an impression and, guided by this, the dental technician thereafter will make a prosthesis which maybe cemented to the member 20.

In this connection it should be observed that a device according to the present invention may be used, of course, for attaching a prosthesis to the upper jaw as well as to the lowerjaw. Thus, when reference is herein made to a "lower" and an "upper" member, these expressions refer to the use of the device for attaching a prosthesis, to the lower jaw. Normally, for a complete prosthesis, a plurality of such devices are required, but it will be obvious to the dental surgeon in any specific case how they should be distributed along the jaw bone in order to achieve satisfactory attachment. For that reason only a single device is shown in the drawings. Of course, the device may be used for attaching a prosthesis comprising a single tooth.

Figure 2 shows a variation of the arrangement according to Figure 1. The lower member 27 of the device is shown only quite schematically. The member 27 may be screwed into the drilled and threaded cavity in the jaw bone. Alternatively, it is possible to use the member 27 so as to replace the shaft 17, 26 in the arrangement according to Figure 1. The essential difference between the devices according to Figure 1 and Figure 2 is in the arrangement of the ball joint.

In the arrangement according to Figure 2 the ball 28 is hollow and integral with the first, or lower member 27. It houses a nut 29, which is oval in cross-section, said nut being provided with a threaded hole 30 for engagement with a downwardly directed threaded pin 31 which is integral with the second, or upper, member 32. The latter serves for the attachment of the prosthesis 33. As a result of the screw-thread engagement between the pin 31 and the threaded hole 30 the ball joint may be locked in its adjusted position by turning all of the pin construction 31—32 so that the ball 28 is clamped between the nut 29 and the socket 19.

The attachment of the prosthesis 33 to the member 32 may in the arrangement according to Figure 2 take place in the same way as already described in connection with Figure 1. Alternatively, the prosthesis may be secured to the member 32 by a screw 34 which is screwed through the prosthesis 33 into a threaded hole 35 in the member 32.

Figure 3 shows a modification of the arrangement according to Figure 2, the modification rendering it possible for a parallel displacement to take place between the lower and the upper members of the device perhaps in connection with a change of direction. This makes it necessary to have a third member 32″ and two ball joints, one between the first member 27 and the second member 32′ and another one between the member 32′ and said third member to which the prosthesis will be attached. The two ball joints are shown in Figure 3 to be made in the same way as the single ball joint according to Figure 2. For this reason also the same reference numerals have been used, however the lower ball joint reference numerals have been provided with a prime and those of the upper ball joint with a second prime.

The locking of the ball joint need not necessarily take place by means of a locking pin of the type shown in the embodiments so fare described, but it may also advantageously be effected by means of an elongate flexible tensioning component in the form of a wire or the like. An arrangement of the last mentioned type is shown in Figure 4.

In this case, therefore, the means for adjusting and locking the ball and socket relative to one another comprise such a tensioning component which in this instance is a twisted wire, or small-diameter wire rope, 36. The ball 16 is integral in Figure 4 with the upper end of the lower member 27 of the device and is a semi-spherical dome having a central aperture 37, which in cross-section is of inverted substantially frusto-conical configuration. From the bottom of the aperture 37 there extends a

blind hole 38 drilled in a direction downwardly into the lower member 27. This blind hole is internally threaded for engagement with a threaded plug 39 having a central bore, through which the wire 36 extends so that it will be retained in a given position against withdrawal when the plug is screwed into the hole 38. The socket 40 co-operating with the ball 16 is in this case formed at the lower end of the upper member 20. Its internal surface is concave to permit sliding contact with the ball 16, and it is also provided with an aperture for the wire 36 so that the latter may extend in stretched condition through both of these apertures, even if the lower member 27 and the upper member 20 are inclined relatively to each other at an included angle of substantially less than 180°.

In the upper member 20 there are provided some suitable means for tensioning the wire 36, after the member 20 has been placed in correct angular position in relation to the lower member 27. These tensioning means may comprise, for instance as shown in Figure 4, a plug 41 screwed into an internally threaded through-bore in the member 20. Said through-bore is co-axial with the socket aperture and is an extension thereof. The plug 41 is further provided with a hole for the attachment of the wire 36, which hole is widened at its upper end portion to form an internally threaded counterbore 42. The wire is attached to the hole so that it will be stretched when the plug 41 is screwed upwardly. The attachment of the prosthesis 48 may suitably take place by means of a sleeve 45 and a screw 44. The sleeve 45 includes two spaced flanges 46 and 47 which to anchor the prosthesis 48 thereto.

A modification of the arrangement illustrated in Figure 4 is shown in Figure 5. In this case the ball, or ball component, 49 is not mechanically combined with either the lower member of the device or with the upper member thereof. It is spherical and is provided with two conical recesses 50, 51 opposing each other, and meeting in the centre part of the ball. The width of the conical recesses 50 and 51 at their junction is just sufficient to permit the wire 36 to pass therethrough and thus through the ball. The wire 36, as earlier described, is secured at both ends and can be tensioned. Thus, a conventional wire lock 52 is provided in the interior of the lower member 27. This wire lock comprises two parts 53, 54, directed in opposite directions said parts being provided at their inner surfaces adjacent the wire 36 with hooks for attachment of the wire; their outer surfaces are tapered so that they can be pressed together by pressure from the inner tapering wall of the bore through the lower member 27. A helical spring 55 is disposed between a washer 56 and the lower end faces of the two parts 53, 54 so as to urge them upwardly, which means to say into the narrower part of the tapered bore in the lower member 27. At its upper end the wire is attached to the plug 41 by means of a bore therein, said bore being also tapered. The end of the wire 36 is mounted after having been widened by means of a wedge 57. The plug 41, as was the case in the embodiment according to Figure 4, is screwed into an internally threaded through-bore in the upper member 20 which carries the prosthesis 48.

In the embodiment according to Figure 6 the hollow ball 28 is substantially semispherically formed. The nut 64 which is provided with a projection extending towards the bottom of the hollow ball 28 engages a downwardly directed threaded pin 65 which extends to the lowermost surface of the projection and forms therewith the seat for one end of a helical spring 66. The other end of the spring rests on the bottom of the spherical hollow in the ball 28. In other respects the device is constructed in substantially the same manner as the device according to Figure 2, and most parts corresponding to each other have therefore also been provided with the same reference numerals. By means of the helical spring 66 the nut 64 is pressed upwardly onto the ball 28 so that by friction between these two parts the member 58 will be prevented from rotation when the threaded pin connected to the part 59 is turned upwardly. The prosthesis 33 is moulded to a sleeve 61 and both are secured to the member 58 by means of a screw similar to the screw 44 in Figure 4.

It may happen that the dental surgeon during his work with the device will cause inadvertent turning of certain parts which should not be turned. This especially concerns screwing in the threaded parts. To prevent such inadvertent turning there is provided an outer hexagonal edged profile 67 on the member 58 (Figure 7).

A further hexagonal profile 68 is provided on the lower member 27 as seen from the device shown in Figure 7, which is not shown in section. In other respects the device illustrated in Figure 7 is similarly shaped as that shown in Figure 6. The last mentioned hexagonal profile is intended to be used when screwing the lower member 27 into the jaw bone.

While some embodiments of the invention have been described in detail it is to be understood that the invention shall not be limited to these embodiments, but that different kinds of modifications or combinations between the different embodiments may be made within the scope

of the invention as defined by the appended claims.

WHAT WE CLAIM IS:—

1. A device for securing in the jaw bone for the attachment of a dental prosthesis, the device comprising a first member and a second member; ball joint means between said first member and said second member to permit universal movement between said members, said ball joint means comprising a co-operating ball part and socket part and there being provided manually adjustable means for displacing the ball part relative to the socket part whereby said ball part may be moved into firm engagement with the socket part to lock the joint and secure said members in a predetermined relationship relative to each other.

2. A device as claimed in claim 1, in which the ball part is hollow and houses a screw device which is adjustable by said manually adjustable means into engagement with the wall of said ball part to displace said wall into firm engagement with the socket part to effect locking.

3. A device as claimed in claim 2, in which the socket part is located on one of said members and the ball part is located on the other of said members and wherein said one member carries a screw threaded portion engaging with a complementary screw threaded nut component which component is located within the hollow ball part and is displaced into engagement with said wall of the ball part to effect locking by rotation of said screw threaded portion.

4. A device as claimed in claim 3, in which the ball part is integral with the said other member.

5. A device as claimed in either claim 3 or claim 4, wherein the nut component is spring loaded to be biased into engagement with the said ball of the ball part.

6. A device as claimed in claim 1, in which the socket part comprises a ball claw within which the ball part is received and said manually adjustable means comprises a screw device carried by the member which carries the socket part, said screw device being engageable with the ball part and adjustable relative to the socket part to displace the ball part relative to the socket part to effect locking.

7. A device as claimed in claim 6, in which the socket part is integral with one of said members and said screw device is screw adjustable through that one member into engagement with the ball part.

8. A device as claimed in claim 1, wherein the manually adjustable means comprises an elongate flexible tensioning component extending between said first and second members, said tensioning component being anchored relative to said first and second members, and wherein at least one of said anchorages is adjustable relative to the member which carries it to tension said tensioning component and to displace the ball part relative to the socket part to effect locking.

9. A device as claimed in claim 8, wherein said adjustable anchorage comprises a screw threaded plug to which an end of said tensioning component is secured, said plug being received and adjustable within a screw threaded bore in said first member.

10. A device as claimed in claim 8 or claim 9, wherein said ball joint means comprises a substantially spherical ball part component engaging with a socket part on said first member and with another socket part on said second member, said tensioning component extending through said ball part component.

11. A device as claimed in any one of the preceding claims and comprising a third member; second ball joint means between said second member and said third member to permit universal movement between said members, said second ball joint means comprising a co-operating ball part and socket part and there being provided manually adjustable means for displacing the ball part of said second ball joint relative to its socket part whereby that ball part may be moved into firm engagement with the socket part to lock the second joint and secure said second and third members in a predetermined relationship relative to each other.

12. A device as claimed in claim 11 and comprising first manually adjustable means for securing the first and second members in a predetermined relationship relative to each other and second manually adjustable means which is discrete from said first manually adjustable means and for securing the second and third members in a predetermined relationship relative to each other.

13. A device as claimed in claim 12, in which the ball part of the second ball joint means is hollow and houses a screw device which is adjustable by said second manually adjustable means into engagement with the wall of the ball part of the second ball joint means to displace said wall into firm engagement with the socket part of the second ball joint means to effect locking.

14. A device as claimed in claim 13, in which the socket part of the second ball joint means is located on one of said second or third members and the ball part is located on the other of said second or third members and wherein the second or third member on which is located the socket part carries a screw threaded por-

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Sheet 1

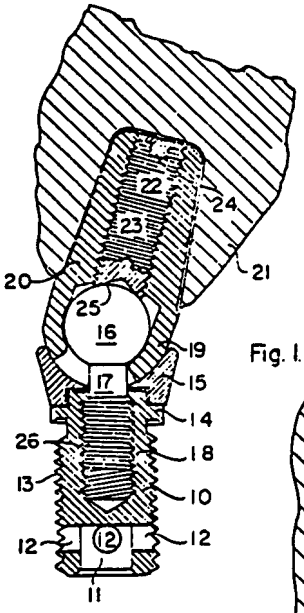

Fig. 1.

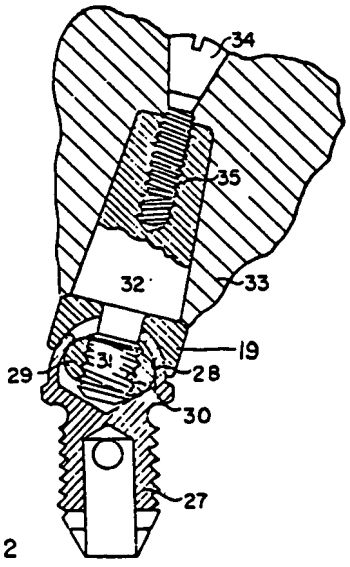

Fig. 2

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Sheet 2

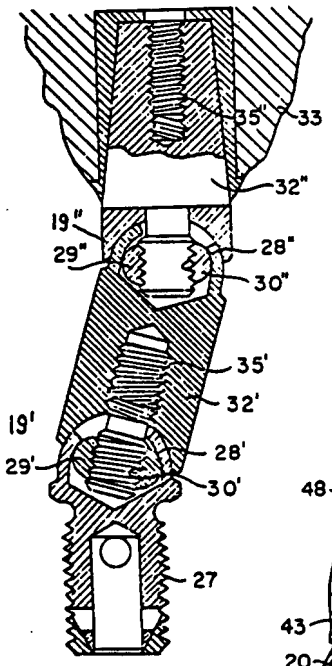

Fig. 3

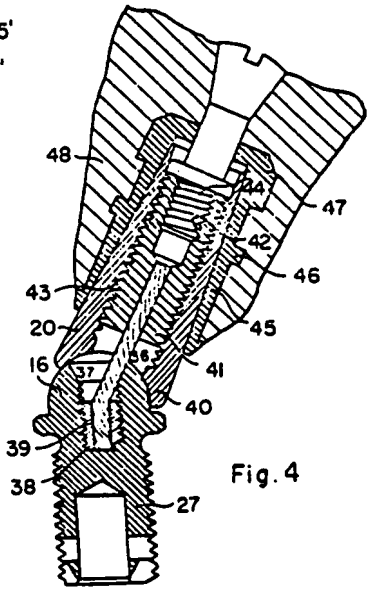

Fig. 4

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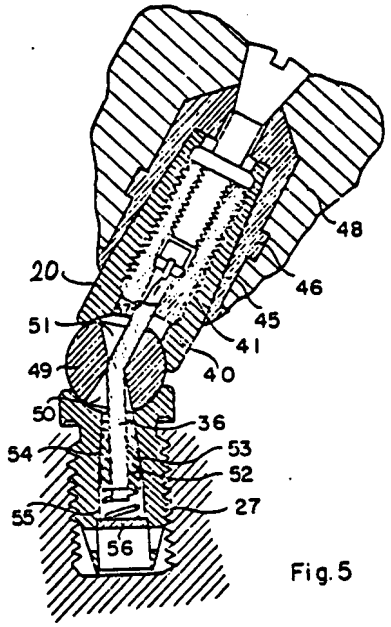

Fig. 5

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Sheet 4

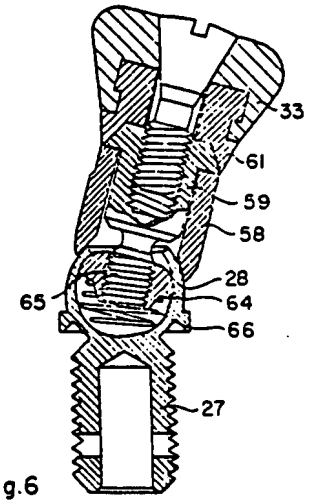

Fig.6

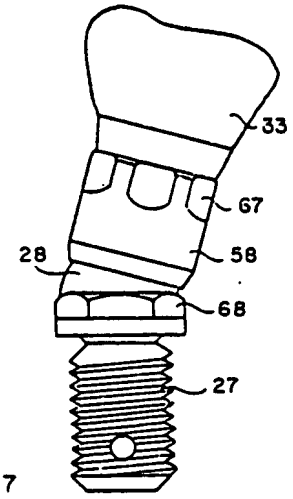

Fig. 7